Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Quebec Region
Canadian Science Advisory Secretariat
Science Advisory Report 2010/029

ASSESSMENT OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE (AREAS 13 TO 17, 12A, 12B, 12C AND 16A) SNOW CRAB STOCKS IN 2009

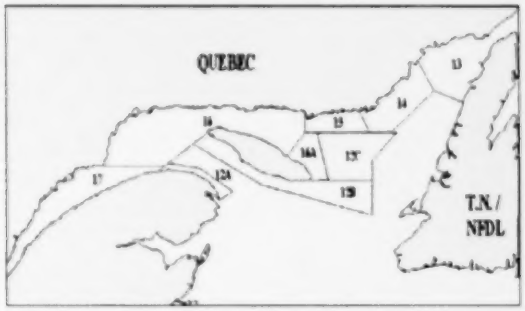


Figure 1: Snow crab management areas in the Estuary and the northern Gulf of St. Lawrence.

Context

The snow crab fishery in the Estuary and the northern Gulf of St. Lawrence began in the late 1960s. The fishery experienced a boom from 1979 to 1985, and a management approach based on the TAC (total allowable catch) was gradually introduced between 1985 and 1995. There are nine management areas (13 to 17, 16A, 12A, 12B and 12C) (Figure 1).

Landings have varied depending on the adjusted TACs based on the recruitment waves and troughs that have affected the fishery (Figure 2), with maximum levels recorded in 1995 (7,879 t) and 2002 (10,372 t). Landings dropped considerably in 2003 owing to the lower TACs established in response to perceived signs of overfishing, particularly in Area 16. Ladings totalled 8,266 t in 2009.

The fishery is directed exclusively at males with a carapace width of at least 95 mm. White crab (crab that has recently moulted) and adolescent males may be returned to water during the fishing season to enhance their meat yield and give them a chance to reproduce. Furthermore, since 1985, when the proportion of white crab in catches at sea exceeds 20%, it automatically triggers the closing of the fishery in the area concerned, in order to minimize the mortality of these very fragile crabs that will be available to the fishery the following year.

The DFO Fisheries and Aquaculture Management Branch for the Quebec Region requested a resource status assessment as well as scientific advice in order to set the 2010 quotas. They also requested advice on the consequences of extending or altering the fishing periods for the snow crab stocks in the Estuary and northern Gulf of St. Lawrence. A scientific peer review was held on February 3 and 4, 2010. Participants included representatives from DFO Science and Fisheries and Aquaculture Management, fishing industry, provincial governments and First Nations.

SUMMARY

- Generally, in 2009, stocks in the Estuary and northern Gulf of St. Lawrence were characterized by a stable or slightly decreasing commercial biomass. Lower North Shore stocks (15-14-13-12C and 16A) were mostly made up of intermediate-shell crab, whereas stocks further west or in the south (16, 17, 12A) had a significant proportion of recruits. The accumulated biomass available to the fishery in 2010 is highly variable according to the stocks. It is low for some stocks that seem to be nearing a recruitment trough while it remains high for others. Area 16 is an exception as it seems to be nearing a recruitment trough despite presenting a high abundance. Recommendations for 2010 are status quo in terms of TAC in all areas except for Area 13. The status quo promotes stock stability where the TAC has already been adjusted downward as a result of lower biomass, or in other cases, provides for moderate exploitation of stocks that still have a high accumulated biomass, although it may be decreasing, before an overly large quantity is lost to commercialization or reproduction.

- Advices for 2010 encourage the maintenance of an adequate reproductive biomass for males so as to not adversely affect the recovery or maintenance of the population in a given area. Recommendations assume that the natural mortality rate will not differ in 2010 compa.ed with previous years.

The status quo with 2009 is recommended for the TAC in 2010 in Areas 17, 16, 15, 14, 12A, 12B, 12C and 16A:

In Area 17, the TAC decrease between 2006 and 2008 provided some stability in terms of catch rates. However, the predominance of recruits in the landings suggests that the exploitation rate is high. Recruitment could remain at a similar level as in 2009 over the next 2-3 years.

In Area 16, the relative stability of the catch rates in the postseason survey and the predominance of recruits in the landings suggest that the exploitation rate should not be increased in 2010. Recruitment outlooks over the medium term are positive which will help maintain a relatively high biomass.

In Area 15, the accumulated commercial biomass appears to be relatively high and based on the postseason survey results, it was comparable in 2009 and 2008, which suggests that the same fishing pressure can be maintained without causing any negative impact on the 2010 stock. Indicators do not suggest any significant recruitment over the next 2-3 years.

In Area 14, the stock appears to show a certain balance between sampling and recruitment since 1999. Recruitment to the fishery has not been high enough since 1999 to generate a significant increase in available commercial biomass, except for 2003 when the TAC was significantly reduced. However, the high proportion of intermediate-shell crab in the landings since 1999 suggests that the exploitation rate has not been excessive.

In Area 12A, the TAC decrease from 2005 to 2008 has led to some stabilization in catch rates but at a low level, suggesting that the exploitation rate should not be increased. Indicators do not suggest significant recruitment for 2010.

In Area 12B, although the catch rate has been stable for several years, the gradual increase in the proportion of recruits in the landings, and the percentage of recruits observed in the postseason survey of 2009 suggests a growing dependence of the fishery on recruitment. In this context, the exploitation rate should not be increased in 2010.

In Area 12C, stock status has been relatively stable since 1997. Various indicators suggest some stability for 2010 and the presence of a high proportion of intermediate-shell crab in the landings suggests that the exploitation rate was not excessive in 2009. There are four adjacent areas to Area 12C which were also somewhat stable and where quotas similar to 2009 have been recommended.

In Area 16A, the brief historical series of the commercial fishery and postseason surveys do not provide much context for interpreting the catch rate declines observed in 2009. Given 1) the stability in the four neighbouring areas, on which Area 16A is partially dependent and 2) the high proportion of intermediate-shell crab in the landings from Area 16A, suggesting a moderate exploitation rate, the quota can be maintained at the same level as in 2009.

In Area 13, following the step-by-step approach adopted upon the reopening of the area in 2008, a TAC increase of 25%, of 185 t in 2010 and 2011 is recommended. The predominance of intermediate-shell crab in the landings from Area 13 suggests that the exploitation rate was not excessive in 2008 and 2009.

INTRODUCTION

Species Biology

In Canada, snow crab can be found from the southern tip of Nova Scotia to midway up Labrador as well as in the Estuary and Gulf of St. Lawrence. In the Gulf of St. Lawrence, males of commercial size live at depths of around 60-220 m, except during their moulting and reproductive period when they migrate to shallower waters. Snow crab stop growing after their terminal moult. The male is referred to as immature or an adolescent (small claws) prior to the terminal moult and as an adult (large claws) afterward. Males range in carapace width (CW) from 40 mm to 165 mm after their terminal moult. If they do not do their terminal moult before, males reach legal size (CW of 95 mm) at about nine years of age. Snow crab recruitment is periodic or episodic and varies considerably over a cycle of 8 to 12 years. The recruitment situation in the fishery can be determined through the regular monitoring of catches (size, carapace condition) and effort (catch per unit effort (CPUE)), and confirmed by scientific trap and trawl surveys.

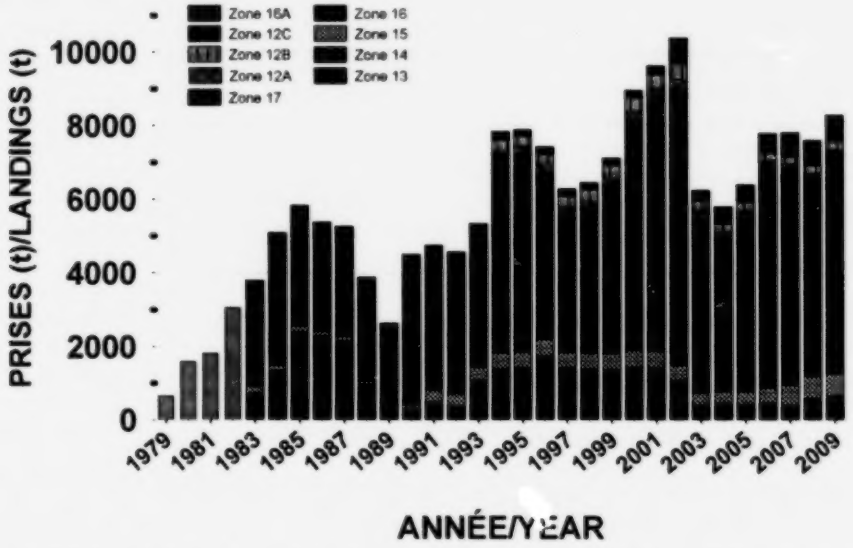


Figure 2. Snow crab landings in the Estuary and northern Gulf of St. Lawrence. From 1979 to 1982, landings were not differentiated per area.

ASSESSMENT OF THE RESOURCE

Fishing data derived from logbooks, processing plant purchase slips and dockside weighing summaries, along with catch sampling data obtained from the Observers Program and DFO samplers, are the basis for the analyses of all areas. In 2009, a trap-based research survey was carried out by Industry in all fishing areas and the findings were incorporated into the stock status analyses. These surveys help determine the mean NPUE (numbers per unit effort) per area for commercial size crab and the NPUE for adolescent crab categories of over 78 mm carapace width. The results from the trawl research surveys conducted in 2008 and 2009 in Areas 13 and 17 were used to calculate an abundance index for juvenile or adult crab.

The raw CPUE (catches per unit effort) for the fishery were standardized using an additive model to account for seasonal changes, gear type, soak time and fishing site. The proportion of recruits (or new crabs), recognizable with a new carapace (carapace condition 1 and 2), was determined by dockside samplers.

Data on the size structure of crab sampled at sea, dockside and during trap surveys were also used.

Until now, data on female insemination levels have been collected sporadically in certain areas. An annual systematic sampling of each area is preferred in order to use this parameter for stock status assessments, because it is a measure of female mating success and relative abundance of large adult males.

Area 17

Fishery Description

There are 22 active license holders in Area 17. The TAC dropped by 44% between 2006 and 2008 and remained unchanged in 2009 at 1,430 t (Figure 3), including 172 t in temporary allocations. The fishing season opened on April 1st and closed on June 23rd, and the TAC was met.

Resource Status in 2009

In the commercial fishery, the standardized CPUE was maintained at high values from 2000 to 2004 and dropped by 50% between 2004 and 2008 (Figure 4). It increased in 2009, but remained low, slightly above the values recorded during the last recruitment recession in 1997. The proportion of recruits (new crabs) (conditions 1 and 2) has been increasing in the landings over the last few years (Figure 5). Oppositely, the proportion of intermediate-shell crab (condition 3) has dropped. The latter had accumulated during the last recruitment wave and had largely supported the fishery between 1999 and 2006. The proportion of old crabs (conditions 4 and 5) in the landings was less than 2% in 2009. The mean of legal-size crab caught at sea, which increased between 1999 and 2004, dropped in 2005 and 2006 and then rose again in 2007 to a value that has remained stable until 2009 at 112.4 mm (Figure 6).

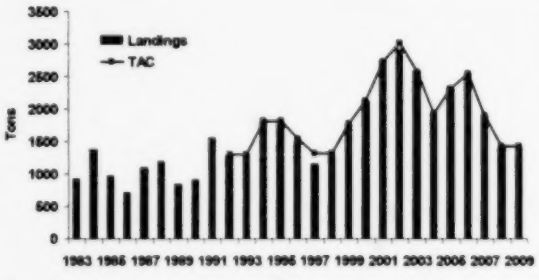


Figure 3. Landings and TAC in Area 17 between 1983 and 2009.

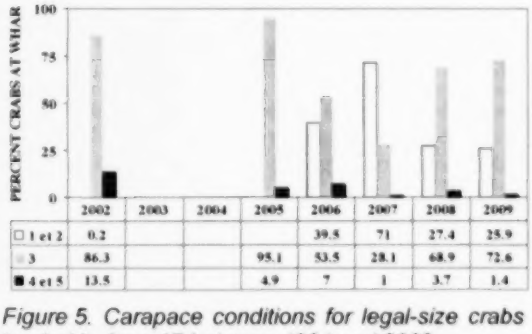


Figure 5. Carapace conditions for legal-size crabs landed in Area 17 between 1994 and 2009.

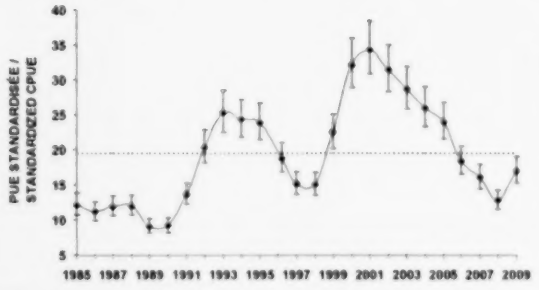


Figure 4. Standardized CPUE ± confidence interval in the commercial fishery between 1985 and 2009 in Area 17. The dotted line shows the data series mean.

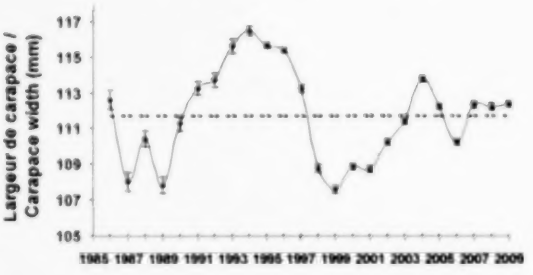


Figure 6. Mean carapace width ± confidence interval for commercial crabs sampled at sea between 1986 and 2009 in Area 17. The dotted line shows the data series mean.

Results from the postseason trap survey, a data series that began in 1996 on the north shore and in 1999 on the south shore, indicated a drop in the NPUE of over 50% between 2005 and 2007, followed by stable and below average values up to 2009 (Figure 7). The number of crabs left by the fishery, intermediate-shell or old crabs (conditions 3, 4 and 5) dropped sharply between 2005 and 2009. The number of recruits (conditions 1 and 2) remained near the mean between 2005 and 2008 and then increased considerably in 2009 (Figure 8), which significantly contributed to maintain the commercial biomass level which should become available early in the 2010 season.

After declining sharply from 2001 to 2003, the average number of adolescents of 78+ mm captured in traps increased until 2007 and then declined in 2008 and has increased again in 2009 (Figure 8). The mean size of legal size crabs in the postseason survey has changed little since 2003 and is expected to remain similar in 2010.

Results from the trawl survey conducted on the north shore of the Estuary indicated that the abundance of adolescents between 78 and 95 mm has been stable since 2005 and that adolescents between 40 and 78 mm were less abundant in 2009 than in the previous survey in 2007. There was a sharp increase of males of 40 mm and less in 2009.

In 2009, the average amount of sperm stored in the female's spermatheca remained above the level required for a high success rate of fertilizing eggs.

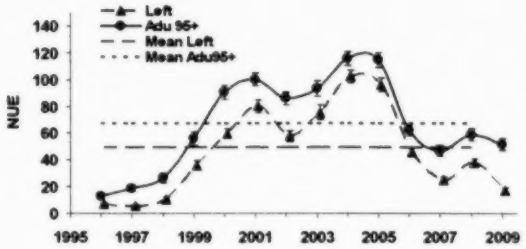


Figure 7. Catch rates (NPUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the fishery from the postseason survey in Area 17 between 1996 and 2009.

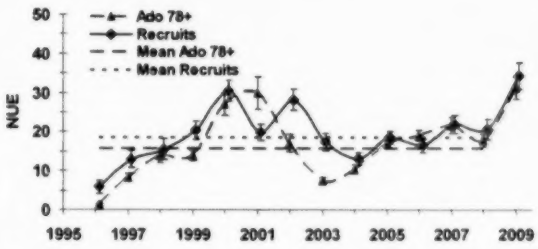


Figure 8. Catch rates (NPUE), with confidence interval and mean, of adolescent crab of 78+ mm and recruits, from the postseason survey in Area 17 between 1996 and 2009.

Conclusion and Advice

TACs and landings totalled 1,430 t in 2008 and 2009.

The catch rate in the commercial fishery increased in 2009, but remains well below the 1996-2008 average. Landings were made up mostly of recruits and their proportion increased between 2005 and 2009.

The 2009 postseason survey suggests that harvesting yields in 2010 will be comparable to those of 2009 and that landings will be mostly composed of recruits.

The size of crabs caught in the 2009 commercial fishery was stable and has been slightly above average since 2007; it is expected to remain at that level in 2010 based on the postseason survey.

The postseason survey results indicated an increase in the abundance of adolescents of 78+ mm, while the trawl survey conducted in 2009 indicated, compared to 2007, that the abundance of adolescents of 78-95 mm was stable. It also showed that the abundance of adolescents of 40-78 mm decreased and that the abundance of crabs of less than 40 mm rose sharply.

The TAC decrease from 2006 to 2008 provided some stability in the catch rates, but the predominance of recruits in the landings suggests that the exploitation rate is high. Recruitment could remain at a level similar to that of 2009 for the next two or three years.

Recommendation

The status quo (2009) is recommended for 2010.

Area 16

Fishery Description

In Area 16, 39 fishermen hold regular snow crab fishing licenses in group A (92.7% of the TAC) and 20 in group B (7.3% of the TAC). The TAC was met and it increased by 15% from 2008 to 2009, peaking at 4,606 t (Figure 9). The fishery opened on April 13th and closed on July 18th.

Resource Status in 2009

In the fishery, the standardized CPUE dropped from 2000 to 2003, but increased subsequently due to a significant TAC decrease in 2003. It reached high values in 2005 and 2006. In 2007, it dropped by 30% and then remained stable up to 2009 (Figure 10). Recruits have made up the majority of landings since 2006 and, oppositely, the proportion of intermediate-shell (condition 3) has been relatively low over the same period (Figure 11). The mean size of legal-size crab sampled at sea, which had begun increasing in 2003 following a sharp downward period, has been clearly above average since 2006. In 2009, the mean size was 111 mm (Figure 12).

Postseason trap surveys, conducted every fall since 1994, showed that the NPUE for legal-size crabs increased significantly in 2003, and have then remained relatively high up to 2009 (Figure 13). The number of intermediate-shell or old crabs (conditions 3, 4 and 5), left by the fishery, has been declining since 2007 while the number of recruits (conditions 1 or 2) has risen over the same period (Figure 14), which helped maintain high catch rates for legal-size crab in the postseason survey. The available biomass at the beginning of the 2010 season should therefore not differ from that of 2009, but would consist of a higher proportion of recruits. The average size of adult males of 95+ mm increased from 2003 to 2006 and did not change much thereafter. It was 110.5 mm in the 2009 survey. The mean NPUE of adolescents of 78+ mm has been significantly above average since 2007 (Figure 14), which suggests a good medium-term recruitment.

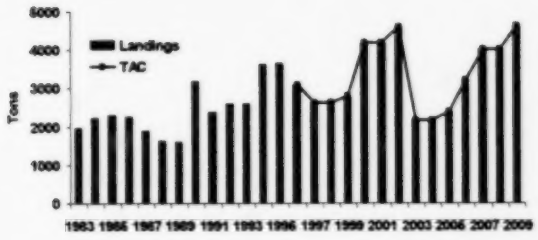


Figure 9. Landings and TAC for Area 16 between 1983 and 2009.

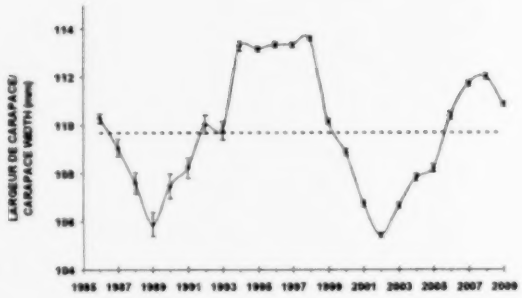


Figure 12. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1986 and 2009 in Area 16. The dotted line indicates the data series mean.

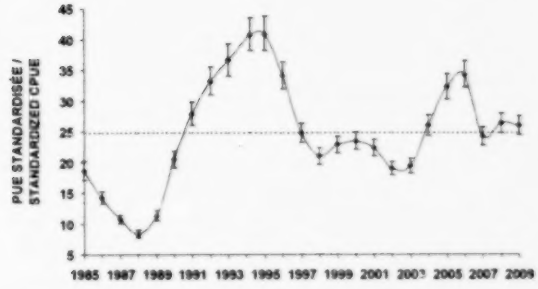


Figure 10. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2009 in Area 16. The dotted line indicates the data series mean.

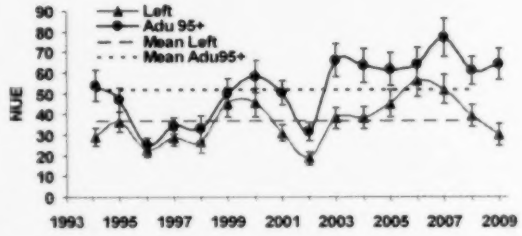


Figure 13. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 16 between 1996 and 2009.

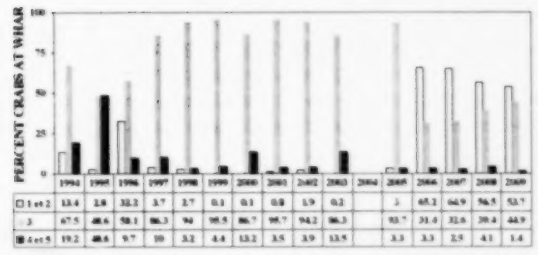


Figure 11. Carapace conditions of legal-size crab landed in Area 16 between 1994 and 2009.

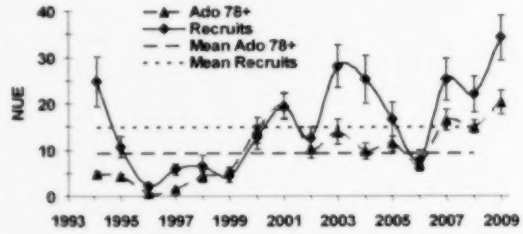


Figure 14. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 16 between 1996 and 2009.

Results from the trawl survey conducted in St. Marguerite Bay, near Sept-Îles, showed a high abundance of adolescents of 40-95 mm CW in 2009, suggesting a recruitment wave over a period of a few years.

The spermatheca of females were not as full in 2009 which indicates a lower availability of larger males.

Conclusion and Advice

The TAC increase by 15% between 2008 and 2009, and peaked at 4,606 t. Catches totalled 4,576 t in 2009.

The catch rate in the commercial fishery was stable in 2009 compared to 2008 and near the 1994-2008 average. The landings included mostly of recruits.

The 2009 postseason survey suggests that harvesting yields in 2010 will be comparable to those of 2009 and that landings will be mostly composed of recruits.

The size of crabs caught in the 2009 commercial fishery was clearly above average; it is expected to remain high in 2010 based on the postseason survey.

The postseason survey results indicated that the abundance of adolescents of 78+ mm was relatively high. Results from the trawl survey conducted in the western part of the area showed a high abundance of adolescents of 40-95 mm.

The stability of catch rates in the postseason survey and the predominance of recruits in the landings suggest that the exploitation rate should not be increased in 2010. The recruitment prospects in the medium term are good, which will help maintain a relatively high biomass.

Recommendation

The status quo (2009) is recommended for 2010.

Area 15

Fishery Description

Area 15 has 8 regular fishermen. In 2008 and 2009, the TAC peaked at 539 t (Figure 15), including 55 t in temporary allocations. In 2009, the fishery opened on April 16th and closed on August 14th and the TAC was met.

Resource Status in 2009

The standardized CPUE from the commercial fishery, in decline from 1996 to 2002, increased gradually beginning in 2003, as a result of lower TACs in 2002 and 2003, and reached high values in 2007 and 2008 before decreasing again in 2009, but at a level that remains high (Figure 16). The proportion of recruits (conditions 1 and 2) landed gradually decreased between 2006 and 2009 and oppositely, intermediate-shell crab (condition 3) increased over the same

period and represented the majority of crabs landed in 2008 and 2009 (Figure 17). Very few old crabs (conditions 4 and 5) have been landed since 2005. Between 2005 and 2007, the mean of legal-size crabs sampled at sea increased from 106.1 mm to 112.1 mm, and then remained stable until 2009, measuring 112.3 mm (Figure 18).

The scientific trap survey, which has been conducted since 1998, showed that the mean NPUE of legal-size crab increased as of 2001 to reach high values in 2006 and 2007. The average NPUE then declined in 2008, but at a value well above the series average and remained stable in 2009 (Figure 19). The abundance of intermediate-shell or old crabs (conditions 3, 4 or 5) is strongly correlated with that of all legal-size crab and was also, in 2009, well above average (Figure 19). The NPUE of recruits (conditions 1 and 2) has been below average since 2007 (Figure 20) and recruits represented only a small percentage of legal-size crab catches in the postseason survey. Thus, the postseason survey results suggest that the available biomass at the beginning of the 2010 season will vary little from that of 2009 and would consist of a large proportion of intermediate-shell or old crabs. The mean size of crabs of 95+ mm has increased gradually since 2002, from 103.9 mm in 2002 to 109.9 mm in 2009, suggesting that it should remain high in the 2010 commercial catches. The mean NPUE of adolescents of 78+ mm, which was relatively high from 2002 to 2006, declined significantly in 2007 and remained low until 2009 (Figure 20). The low catches of recruits and adolescents in the postseason survey suggest that the biomass available to the fishery could decrease in the short or medium term.

Conclusion and Advice

TACs and landings peaked at 593 t in 2008 and 2009.

Catch rates in the commercial fishery dropped in 2009 but remained high compared with the 1998-2008 series average. Landings consisted in large part of intermediate-shell crab. Fishing effort was almost entirely concentrated in the western half of the area.

The 2009 postseason survey suggests that the 2010 fishing yields will be comparable to those of 2009 and that the landings will be composed mainly of intermediate-shell crabs.

The mean size of crabs caught in the 2009 commercial fishery were high compared to the average and should remain this way in 2010 based on the postseason survey.

In the postseason survey, the abundance indices for adolescents of 78+ mm have remained below average since 2007.

The accumulated commercial biomass appears to be relatively high and according to the postseason survey results, it was comparable in 2009 and 2008, suggesting that it is possible to maintain the same fishing pressure without causing significant impacts on the stock in 2010. The indicators do not suggest significant recruitment in the next 2 or 3 years.

Recommendation

The status quo (2009) is recommended for 2010.

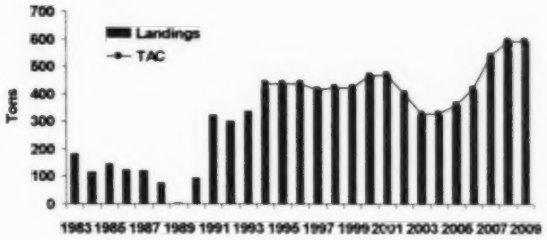


Figure 15. Landings and TAC for Area 15 between 1983 and 2009.

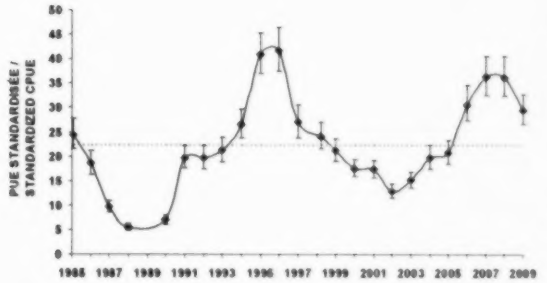


Figure 16. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2009 in Area 15. The dotted line indicates the data series mean.

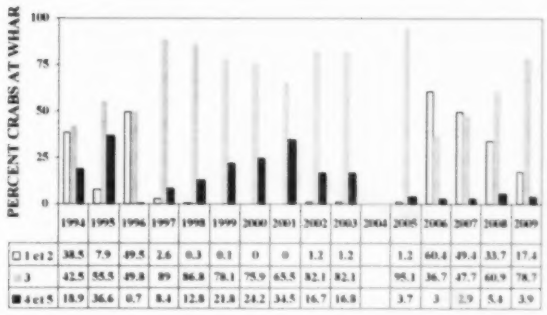


Figure 17. Carapace conditions of commercial crab landed in Area 15 between 1994 and 2009.

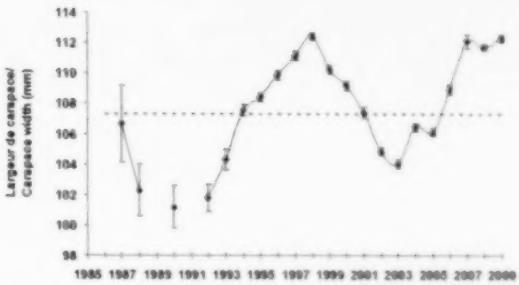


Figure 18. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1987 and 2009 in Area 15. The dotted line indicates the data series mean.

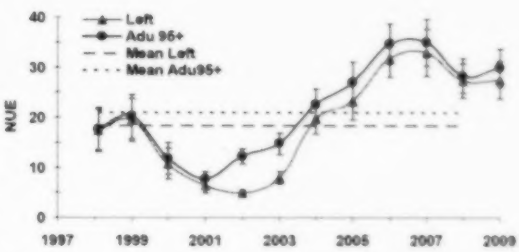


Figure 19. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 15 between 1998 and 2009.

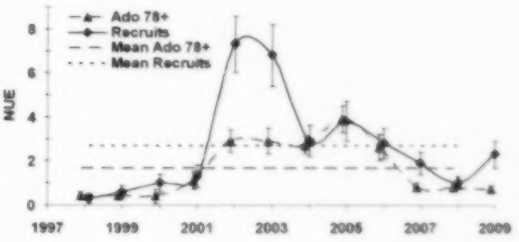


Figure 20. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 15 between 1998 and 2009.

Area 14

Fishery Description

Area 14 has 21 regular fishermen. The TAC increased by 15% to 509 t from 2008 to 2009 (Figure 21), and there were no temporary allocations. In 2009, the fishing season opened on May 6th and closed on August 11th. The TAC was met.

Resource Status in 2009

The standardized CPUE from the commercial fishery was low from 1999 to 2009, except in 2003 (Figure 22) when the TAC was significantly reduced. Thus, the sharp rise in commercial catch rates observed in most traditional areas, in the first half of the 2000s, was not apparent in Area 14. The proportion of intermediate-shell crabs (condition 3) largely dominated the landings in 2008 and 2009 and few old crabs (conditions 4 and 5) were landed (Figure 23). The mean size of legal-size crabs caught at sea dropped from 109.7 mm in 2008 to 107.7 mm in 2009, a value which is still above the series average (Figure 24).

The **scientific trap survey** conducted since 1996 indicates that the NPUE has been relatively stable and clearly below average since 2005 (Figure 25). The abundance of intermediate-shell or old crabs (conditions 3, 4 or 5) is strongly correlated with that of all commercial crab and was weak from 2005 to 2009 (Figure 25). Recruits (conditions 1 and 2) have also been below average since 2005, and only represented a small percentage of legal-size crabs in the postseason survey catches (Figure 26). Thus, the postseason survey results suggest that the biomass available at the beginning of the 2010 season will vary little from that of the last three or four years and will include a high proportion of intermediate-shell or old crabs. The mean size of legal-size crabs has changed little since 2005 and stood at 106.3 mm in 2009. The mean NPUE of adolescents of 78+ mm decreased from 2003 to 2006 and then rose above the average in 2008 and 2009 (Figure 26).

Conclusion and Advice

The TAC and landings increased by 15% to 509 t from 2008 to 2009.

The catch rates in the commercial fishery have remained below average since 1999, except for 2003. In 2009, landings included a majority of intermediate-shell crabs.

The 2009 postseason survey suggests that the 2010 fishing yields will be comparable to those of the past three years and landings will be composed mainly of intermediate-shell crabs.

The mean size of crabs caught in the 2009 commercial fishery was slightly above average and according to the postseason survey, it is not likely to increase in 2010.

The postseason survey results indicate that adolescents between 78-95 mm were abundant in 2008 and 2009.

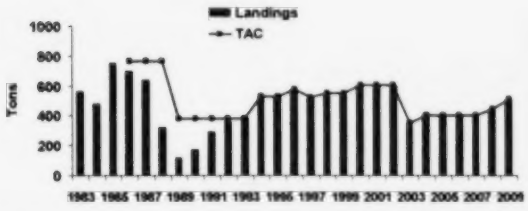


Figure 21. Landings and TAC for Area 14 between 1983 and 2009.

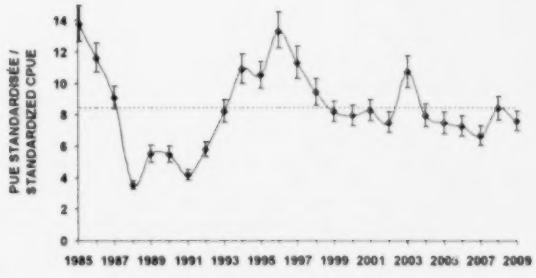


Figure 22. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2009 in Area 14. The dotted line indicates the data series mean.

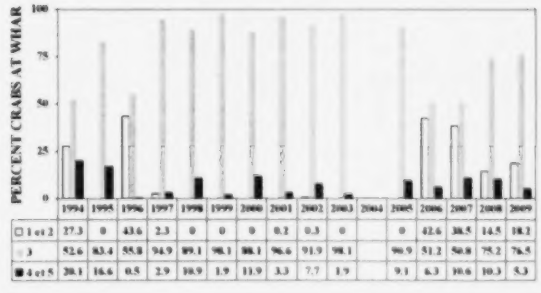


Figure 23. Carapace conditions of commercial crab landed in Area 14 between 1994 and 2009.

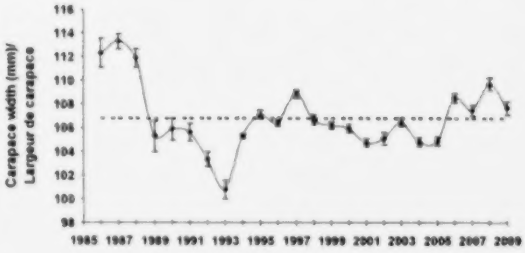


Figure 24. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1986 and 2009 in Area 14. The dotted line indicates the data series mean.

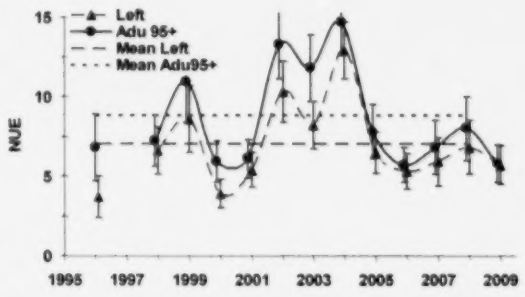


Figure 25. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 14 between 1996 and 2009.

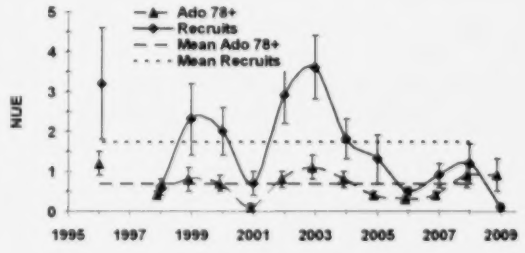


Figure 26. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 14 between 1996 and 2009.

The stock appears to show a certain balance between sampling and recruitment since 1999. Recruitment to the fishery has not been high enough since 1999 to generate a significant increase in available commercial biomass, except for 2003 when the TAC was significantly reduced. However, the high proportion of intermediate-shell crab in the landings during this period suggests that the exploitation rate has not been excessive.

Recommendation:

The status quo (2009) is recommended for 2010.

Area 13

Fishery Description

Area 13 has 43 fishermen from Quebec and 6 from Newfoundland. This area was under moratorium from 2003 to 2007 as a result of a significant drop in biomass. An index fishery with an annual TAC of 50 t was nevertheless authorized in 2003, 2004 and 2006. The area was reopened to the commercial fishery in 2008 with a TAC of 150 t in 2008 and 2009 (Figure 27). TACs were met in each of these years.

Resource Status in 2009

The standardized CPUE from the commercial fishery was slightly higher in 2008 and 2009 compared to the values from 1988 to 2004 (Figure 28). Fishing effort centered primarily on three sites in 2008 and 2009 and the harvested area was relatively weak compared to the total extent of areas traditionally harvested. A strong majority of individuals landed were intermediate-shell crabs (condition 3) in both 2008 and 2009 (Figure 29). The average size of crabs caught at sea in 2009 (105.1 mm) was higher than the average of the historical series (Figure 30) but remains low compared to other areas of the northern Gulf of St. Lawrence.

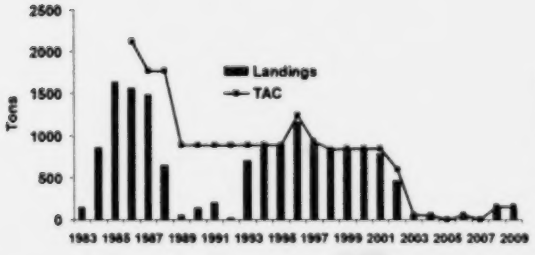


Figure 27. Landings and TAC for Area 13 between 1983 and 2009.

Figure 28. Standardized CPUE ± confidence interval in the commercial fishery between 1985 and 2009 in Area 13. The dotted line shows the data series mean.

The abundance indices (NPUE) obtained from **the scientific trap survey** were standardized to compare the results from beginning of the series in 1999. The mean standardized NPUE for legal-size crabs from the scientific trap survey has been low and stable from 2001 to 2007 on the northern side and then increased in 2008 and 2009, reaching values clearly above the historic series average (Figure 31). On the south side, the survey indicated that the mean NPUE was high between 2006 and 2008, and then dropped in 2009 at a value still above the series average (Figure 32). In the north and south surveys, intermediate-shell or old crabs (condition 3, 4 and 5) were the most abundant in the 2008 and 2009 catches, even though the number of recruits increased on the north side (Figure 33). On the south side, recruits were abundant from 2004 to 2007, then declined to very low values in 2008 and 2009 (Figure 34). Thus, the postseason survey results suggest that available biomass at the beginning of the 2010 season will vary slightly on the north side in 2010 compared to 2009, it will decrease on the south side and in each case, it will be made up of a high proportion of intermediate-shell or old crabs. In the postseason surveys, the mean size of crabs has remained stable since 2004 on each side of the area suggesting that the size of crabs in commercial catches in 2010 will be comparable to that of 2009. The mean NPUE for adolescent crabs of 78+ mm increased on the north side and on the south side it was low (Figures 33 and 34). It is noteworthy that there were no adolescent crabs of 95+ mm observed on the north side in the postseason surveys.

Primiparous female insemination levels suggested an average to low mating success in 2008 and 2009.

The last **trawl survey** covering the northern part of Area 13 occurred in 2008 and showed that the abundance of adult legal-size crab (3.6 crab/10,000 m^2) and adolescent crab between 78 and 95 mm (5.6 crabs/10,000 m^2) was weak. The abundance of adolescents between 62 mm and 78 mm increased in 2008 (34.8 crabs/10,000 m^2) compared with 2006 (15.6 crabs/10,000 m^2). The abundance of males between 40 and 62 mm increased considerably since 2004 to a relatively high value in 2008 (219.3 crabs/10,000 m^2), whereas those less than 40 mm significantly decreased from a reported maximum of 800 crab/10 000 m^2 in 2006 to 207.5 crab/10 000 m^2 in 2008. Based on the 2008 results, the next recruitment wave should last 3 years and would not arrive in the fishery until 2011 if the natural mortality and premature terminal moult rates are not too high and if growth is regular.

Conclusion and Advice

The fishery was reopened in 2008, following a five year moratorium. The TAC was set at 150 t for both 2008 and 2009.

Catch rates in the 2008 and 2009 commercial fishery were slightly above the average for the years when there was a commercial harvest since 1988. The harvested area in 2008 and 2009 was small compared to the sections traditionally exploited in the area. In 2008 and 2009, landings were mostly made up of intermediate-shell crab.

The postseason surveys suggest that fishing yields will be stable in the northern part, but will decrease in the south. Both surveys suggest that landings will be composed mostly of intermediate-shell crabs.

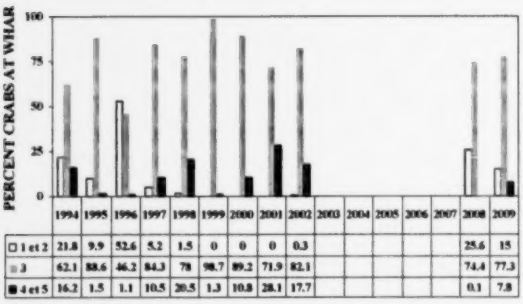


Figure 29. Carapace conditions of commercial crab landed in Area 13 between 1994 and 2009.

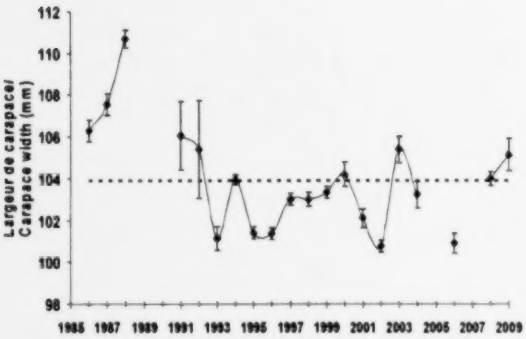


Figure 30. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1986 and 2009 in Area 13. The dotted line indicates the data series mean.

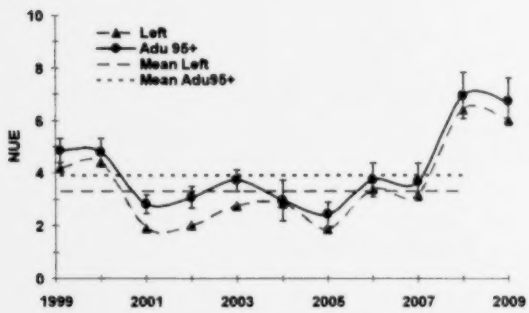


Figure 31. Catch rates (NPUE) for adult crab ≥ 95 mm and those left by the fishery with confidence interval and mean, from the postseason survey in Area 13 north, between 1999 and 2009.

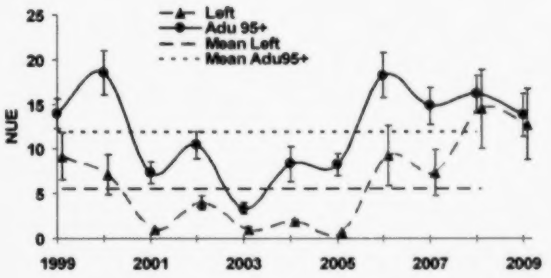


Figure 32. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 13 south between 1999 and 2009.

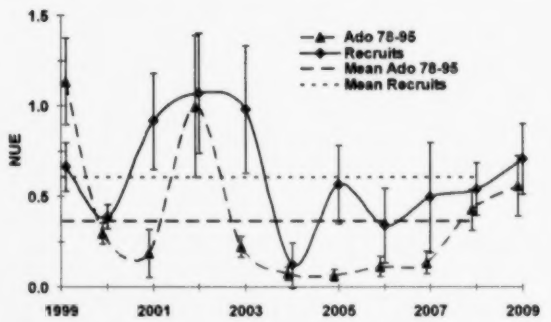


Figure 33. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78-95 mm and larger and for recruits, from the postseason survey in Area 13 north between 1999 and 2009.

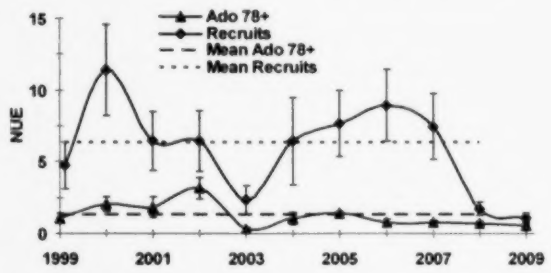


Figure 34. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 13 south between 1999 and 2009.

The mean size of crabs caught in the 2009 commercial fishery was slightly above average and based on the postseason surveys, it should be similar in 2010. The trawl survey results on the north side showed the presence, in 2008, of a high proportion of adult crabs of less than 95 mm, or excluded from the commercial fishery, but with a certain reproductive potential.

The 2008 and 2009 postseason survey results showed that the abundance of adolescents between 78 and 95 mm was slightly above average on the north side and below the mean on the south side. The results of a trawl survey conducted in 2008 on the north side showed a high abundance of adolescent crabs between 40 and 62 mm.

The predominance of intermediate-shell crab in the landings suggests that the exploitation rate was not excessive in 2008 and 2009.

Recommendation

In compliance with the step-by-step approach adopted upon the reopening of the area in 2008, a TAC increase of 25%, of 185 t in 2010 and 2011 is recommended.

Area 12A

Fishery Description

Area 12A has 10 regular licenses. The TAC dropped from 229 t in 2006 to 80 t in 2008 as a result of an overall decrease of commercial biomass abundance indices, and then increased by 10% to 88 t in 2009 (Figure 35). In 2009, the fishery opened on March 26th and closed on June 4th and the TAC was met.

Resource Status in 2009

In the commercial fishery, the standardized CPUE was relatively high between 1999 and 2005, and then dropped sharply between 2005 and 2007. From 2007 to 2009, the CPUE has remained well below the historic series average despite an increase in 2009 (Figure 36). A majority of intermediate-shell crabs (condition 3) were landed every year since 2005 even though the proportion of new crab (conditions 1 and 2) increased significantly in 2008 and 2009 (Figure 37). The mean size of legal-size crabs sampled at sea has increased considerably since 2007 and was 110.2 mm in 2009 (Figure 38).

The **scientific trap survey,** which has been conducted since 2000, indicated that the mean NPUE peaked in 2004 and gradually decreased until 2007 (Figure 39). It has been clearly below average since 2006, as is the number of intermediate-shell or old crabs (conditions 3-5), with which it is strongly correlated (Figure 39). There was a low abundance of recruits in 2008 and 2009 (Figure 40). Postseason survey results suggest that the available biomass at the beginning of the 2010 season will be similar to that of 2009 and will be composed mainly of intermediate-shell crab. The mean size of legal-size adult males increased from 103.9 mm in 2008 to 106 mm in 2009. The mean NPUE for adolescents of 78+ mm declined between 2008 and 2009, but remains near the historical average (Figure 40).

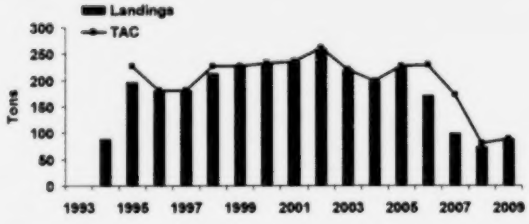


Figure 35. Landings and TAC for Area 12A between 1994 and 2009.

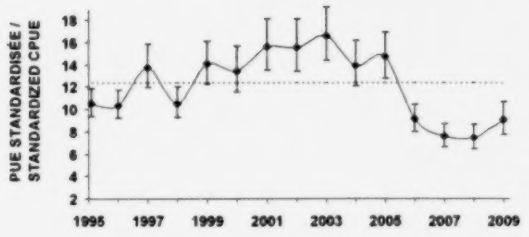


Figure 36. Standardized CPUE ± confidence interval in the commercial fishery between 1995 and 2009 in Area 12A. The dotted line shows the data series mean.

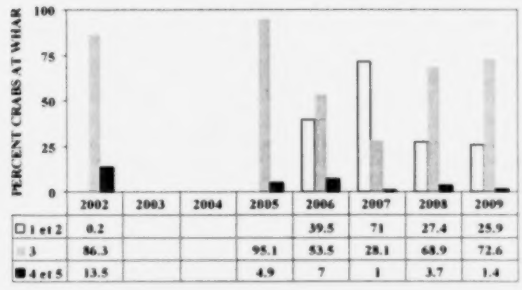


Figure 37. Carapace conditions of commercial crab landed in Area 12A between 2002 and 2009.

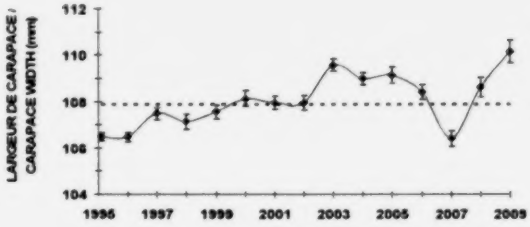


Figure 38. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1995 and 2009 in Area 12A. The dotted line indicates the data series mean.

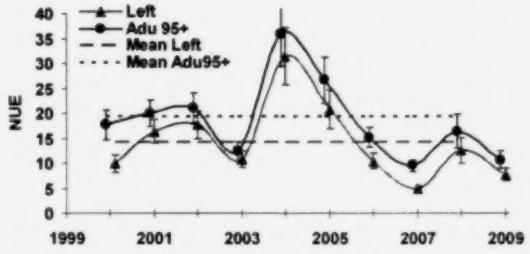


Figure 39. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 12A between 2000 and 2009.

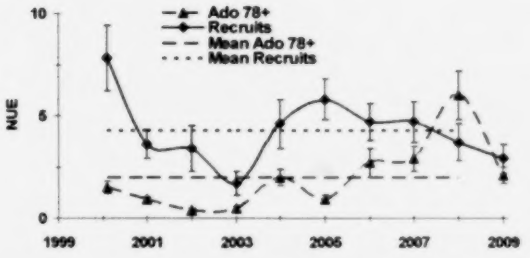


Figure 40. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 12A between 2000 and 2009.

It is important to note that crab abundance in Area 12A is partly due to the overlapping adjacent Area 17 in the west, and Area 12 in the east. Thus, the abundance indices of these two last areas are also weak.

Conclusion and Advice:

The TAC increased by 10% to 88 t in 2008 and 2009 and it was met.

The catch rate in the commercial fishery increased in 2009, but remained well below the 2000-2008 average. Landings were primarily made up of intermediate-shell crab.

The 2009 postseason survey suggests that the fishing yields in 2010 will be comparable to those of 2009 and that landings will be made up primarily of intermediate-shell crab.

The mean size of crab caught in the 2009 commercial fishery was high and should remain that way in 2010 according to the postseason survey.

In the postseason survey, the catch rate for adolescent crab of 78+ mm was relatively high from 2006 to 2008, but dropped in 2009.

The TAC decrease between 2005 and 2008 help create some stability in the catch rates, but at a low level, which suggests that the exploitation rate should not be increase. Indicators do not suggest any major recruitment for 2010.

Recommendation:

The status quo (2009) is recommended for 2010.

Area 12B

Fishery Description

In 2009, Area 12B had 8 commercial fishing licenses. The TAC was increased by 15% to 246 t between 2008 and 2009 (Figure 41). In 2009, the fishery opened on March 26th and closed on July 3rd. The TAC has not been met for several years, primarily because one or two license holders are either totally or partially inactive. Landings totalled 214 t in 2009.

Resource Status in 2009

The standardized CPUE for the commercial fishery has been weak but stable since 2002 (Figure 42). In 2009, it was the near the 2001-2008 average. The stability of this biomass index could be attributed to reduced landings from 2003 to 2006 and by weak landings until 2009. A majority of intermediate-shell crab (condition 3) was landed in 2008 and 2009 even though the proportion of recruits (conditions 1 and 2) was clearly higher than during the 2005-2007 period (Figure 43). The mean size of legal-size crab measured at sea (Figure 44) dropped between 2006 and 2008 and has remained stable in 2009, at the lowest level of the series, 106.5 mm.

The scientific trap survey conducted since 2001 (except in 2005) showed a sharp drop of the mean NPUE of legal-size crab from 2001 to 2003, which remained below the series average

until 2009 (Figure 45). The mean number of intermediate-shell or old crabs (conditions 3-5) caught has also been below average since 2003, whereas the number of recruits (conditions 1 and 2) has increased since 2004 and was clearly above average in 2009 (Figure 46). The available biomass at the beginning of the 2010 season should therefore vary little compared to that of 2009, but will likely of consist of a large proportion of recruits. The mean size of legal-size adult crab, which dropped from 2006 to 2008, increased in 2009, but remains low at 106.1 mm. The mean NPUE for adolescents of 78+ mm increased between 2005 and 2008, and decreased in 2009 to a value nearing the series average (Figure 46).

Conclusion and Advice:

The TAC increased by 15% to 246 t in 2008 and 2009. Landings totalled 214 t.

The catch rate in the commercial fishery was stable, and since 2002, it has been near the 2001-2008 series average. Landings were primarily made up of intermediate-shell crab, even though the proportion of recruits increased between 2007 and 2009.

The 2009 postseason survey suggests that the fishing yields in 2010 will be comparable to those of 2009 and that landings may include a larger proportion of recruits than in 2009.

The mean size of crab caught at sea was stable, but has been weak since 2007. The postseason survey suggests that size could increase in 2010.

In the postseason survey, adolescent crab of 78+ mm were abundant in 2007 and 2008, and decreased to near average in 2009.

Although the catch rate has been stable for several years, the gradual increase in the proportion of recruits in the landings, and the high percentage of recruits observed in the postseason survey of 2009 suggests a growing dependence of the fishery on recruitment. In this context, the exploitation rate should not be increased in 2010.

Recommendation:

The status quo (2009) is recommended for 2010.

Area 12C

Fishery Description

Area 12C has features two banks (north and south sectors) separated by the deep channel of the Jacques-Cartier Strait. It has five regular fishermen. The TAC reached a maximum of 320 t in 2008 and 2009 (Figure 47). Temporary allocations totalling 100 t were granted in 2009. The fishery opened on April 22nd and closed on August 8th. Landings totalled 298 t in 2009.

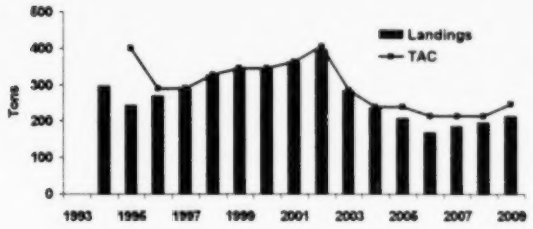


Figure 41. Landings and TAC for Area 12B between 1994 and 2009.

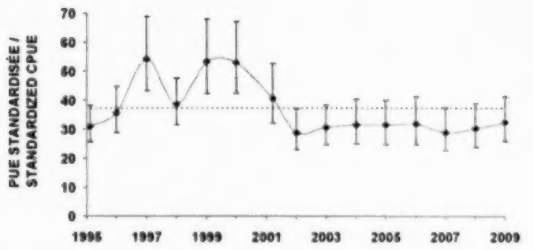


Figure 42. Standardized CPUE ± confidence interval in the commercial fishery between 1995 and 2009 in Area 12B. The dotted line shows the data series mean.

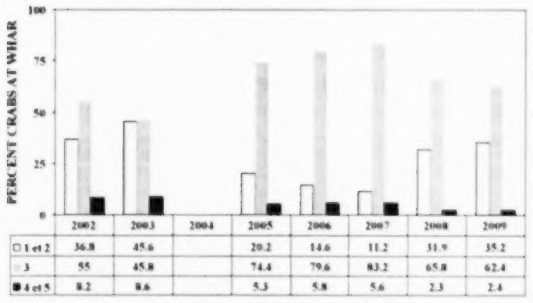


Figure 43. Carapace conditions of commercial crab landed in Area 12B between 2002 and 2009.

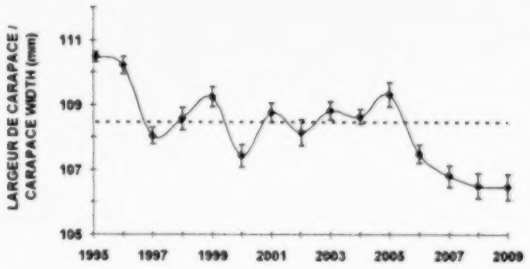


Figure 44. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1995 and 2009 in Area 12B. The dotted line indicates the data series mean.

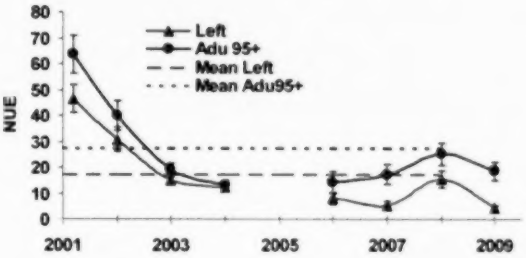


Figure 45. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 12B between 2001 and 2009 (except for 2005).

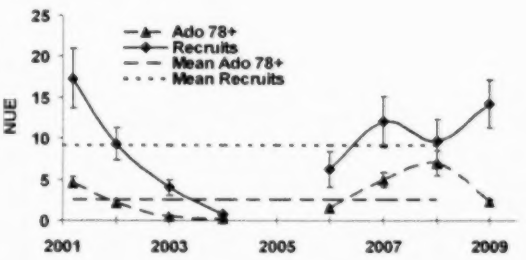


Figure 46. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 12B between 2001 and 2009 (except for 2005).

Resource Status in 2009

The standardized CPUE for the commercial fishery, which plummeted between 1996 and 1997, remained at relatively low values (except for 2008) until 2009 (Figure 48). The proportion of intermediate-shell crab (condition 3) landed decreased from 2005 to 2007 and represented only a quarter of the crabs at landing, and then it increased until 2009 and even represented a strong majority (Figure 49). Oppositely, the proportion of recruits (conditions 1 and 2) has dropped since 2007. The mean size of legal-size crab measured at sea increased considerably between 2002 and 2008 and then decreased in 2009 to a value still well above the average (113.1 mm) (Figure 50). Since 2006, the fishing effort has been more concentrated in the northern part of the area than in previous years.

The scientific trap survey conducted since 2000 showed that the mean NPUE has been weak since 2007 and that it was stable in 2008 and 2009 (Figure 51). Still representing a majority in 2009, the number of intermediate-shell or old crabs (conditions 3-5) caught has reached the lowest value of the series (Figure 51) whereas the number of recruits (conditions 1 and 2) increased in 2009, but still at a value below the series average (Figure 52). The postseason survey results suggest that the available biomass at the beginning of the 2010 season should be comparable to that of 2009 and that it will consist of a majority of intermediate-shell crab. The mean size of legal-size adult crab has remained high and stable since 2007, and measured 110.3 mm in 2009. The mean NPUE for adolescents of 78+ mm increased in 2009 compared to 2007 and 2008, reaching the series average (Figure 52).

Conclusion and Advice:

The TAC was set at 320 t in 2008 and 2009. Catches totalled 298 t in 2009.

The commercial fishery catch rate has not changed significantly since 1997. In 2009, it decreased slightly and was close to the 2000-2008 average. Fishing effort was concentrated mainly in the north, especially near Area 15. Landings were made up primarily of intermediate-shell crab, which have been increasing since 2007.

The 2009 postseason survey suggests that the 2010 fishing yields will be comparable to those of 2009 and that landings will be mainly composed of intermediate-shell crab.

The size of crab caught in the 2009 commercial fishery decreased, but was clearly above the average. According to the postseason survey, it should remain at the same level in 2010.

The postseason survey results indicate there has been a slight increase in the abundance of adolescents of 78-95 mm since 2007, but it was still low in 2009.

The stock status in Area 12C has been relatively stable since 1997. Various indicators suggest some stability in 2010 and the presence of a high proportion of intermediate-shell crab in the landings suggests that the exploitation rate was not excessive in 2009. There are four areas adjacent to Area 12C which also show a certain stability and where quotas similar to those of 2009 were recommended, including Area 15 at the limits where a high proportion of fishing effort in Area 12C is made.

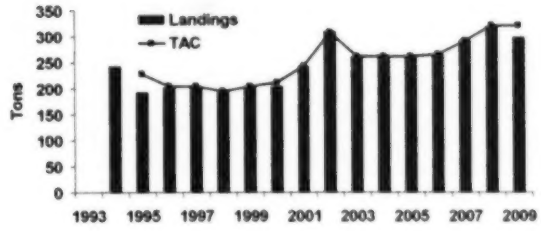


Figure 47. Landings and TAC for Area 12C between 1994 and 2009.

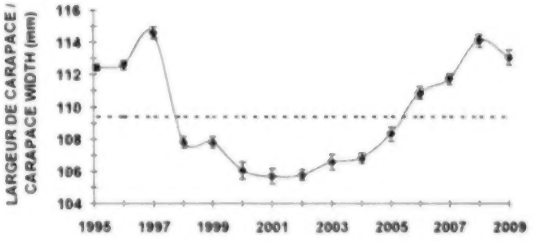


Figure 50. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1995 and 2009 in Area 12C. The dotted line indicates the data series mean.

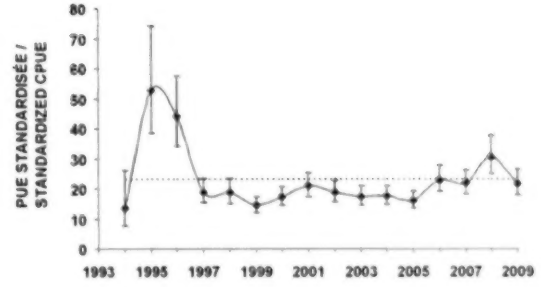


Figure 48. Standardized CPUE ± confidence interval in the commercial fishery between 1994 and 2009 in Area 12C. The dotted line shows the data series mean.

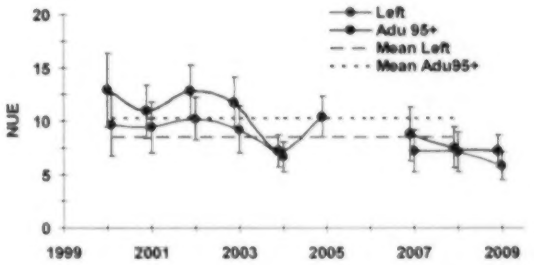
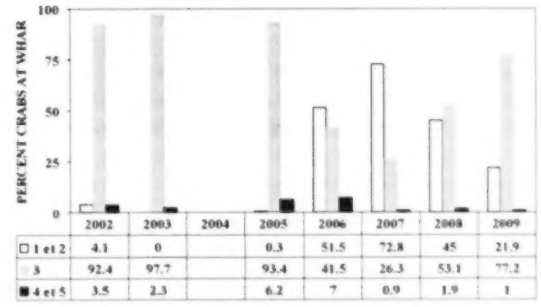


Figure 51. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 12C between 2000 and 2009 (except for 2006).



	2002	2003	2004	2005	2006	2007	2008	2009
1 et 2	4.1	0		0.3	51.5	72.8	45	21.9
3	92.4	97.7		93.4	41.5	26.3	53.1	77.2
4 et 5	3.5	2.3		6.2	7	0.9	1.9	1

Figure 49. Carapace conditions of commercial crab landed in Area 12C between 2002 and 2009.

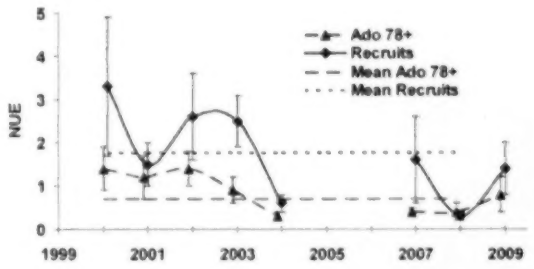


Figure 52. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 12C between 2000 and 2009 (except for 2005 and 2006).

Recommendation:

The status quo (2009) is recommended for 2010.

Area 16A

Fishery Description

Area 16A has only a brief fishing history. Since 2002, it has been accessible to the 43 Quebec fishermen holding a snow crab fishing licence in Area 13. The TAC increased by 15% to 426 t from 2008 to 2009 (Figure 53). Ladings totalled 414 t in 2009. The fishery went from April 16th to July 19th and from July 28th to August 7th.

Resource Status in 2009

The standardized CPUE for the commercial fishery was relatively stable from 2002 to 2007, and increased in 2008 before dropping below the series average value in 2009 (Figure 54). The proportion of intermediate-shell crab (condition 3) in the landings was high in 2008 and 2009, whereas the proportion of recruits (conditions 1 and 2) represented about a quarter of the crabs over the same period (Figure 55). The mean size of legal-size crab measured at sea dropped between 2008 and 2009, but has remained clearly above the series average (110.8 mm) (Figure 56). Fishing effort was mostly concentrated in the northern part of the area.

The scientific trap surveys, conducted since 2002, showed little variation in the mean NPUE of legal-size crab from the beginning of the series until 2008, except for 2005 when it had increased significantly. From 2008 to 2009, both the mean NPUE and the number of intermediate-shell or old crabs (conditions 3-5) dropped, with which it is strongly correlated (Figure 57). The latter are still more abundant than recruits, which had been consistently decreasing between 2002 and 2008, but then increased in 2009 (Figure 58). The postseason trap survey suggests that the available biomass at the beginning of the 2010 season will likely drop, compared to 2009, and landings will mostly consist of intermediate-shell crab. The mean size of legal-size adult crab of 95+ mm increased between 2003 and 2006 to more than 110 mm, and has remained stable up to 2008, before dropping slightly in 2009 to 109.1 mm. The mean number of adolescents per trap, which had been gradually decreasing from 2003 to 2007, increased in 2008 and 2009 (Figure 58).

Conclusion and Advice:

The TAC increased by 15% to 426 t from 2008 to 2009. Landings totalled 414 t in 2009.

The catch rate in the commercial fishery dropped from 2008 to 2009 and landings were primarily made up of intermediate-shell crab. A strong proportion of the fishing effort was conducted in the northern end of the area.

The 2009 postseason survey results suggests that the 2010 fishing yields will be lower than those of 2009 and that landings will be primarily made up of intermediate-shell crab.

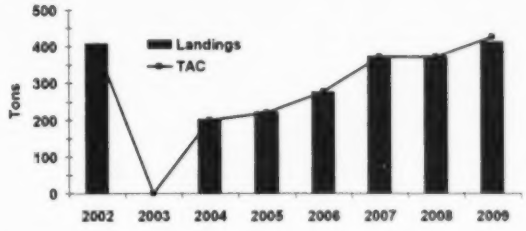


Figure 53. Landings and TAC for Area 16A between 2002 and 2009.

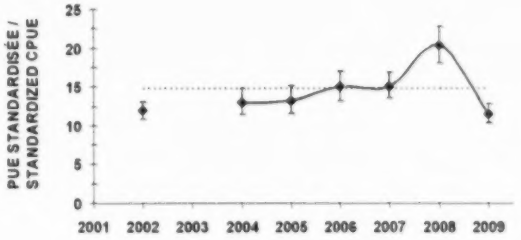
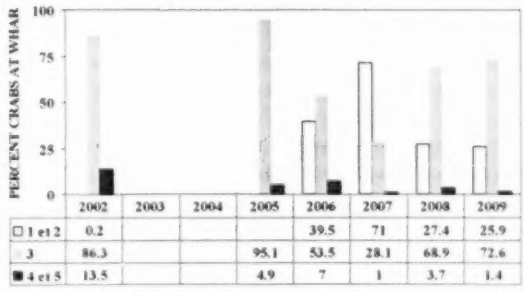


Figure 54. Standardized CPUE ± confidence interval in the commercial fishery between 2002 and 2009 in Area 16A. The dotted line shows the data series mean.



	2002	2003	2004	2005	2006	2007	2008	2009
1 et 2	0.2				39.5	71	27.4	25.9
3	86.3			95.1	53.5	28.1	68.9	72.6
4 et 5	13.5			4.9	7	1	3.7	1.4

Figure 55. Carapace conditions of commercial crab landed in Area 16A between 2002 and 2009.

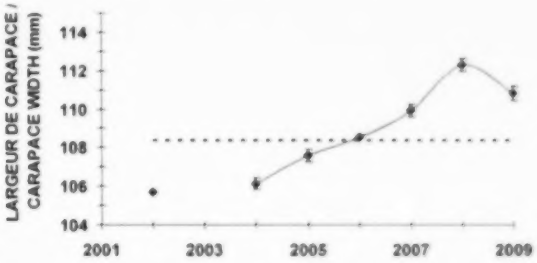


Figure 56. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 2002 and 2009 in Area 16A. The dotted line indicates the data series mean.

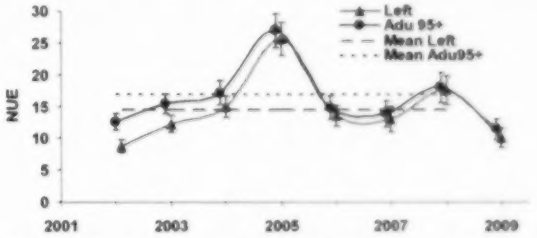


Figure 57. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 16A between 2002 and 2009.

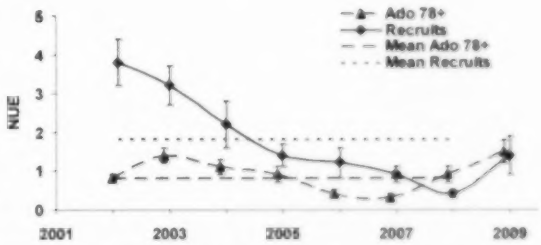


Figure 58. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 16A between 2002 and 2009.

The mean size of crab caught in the 2009 commercial fishery dropped, but remains above average. The postseason survey suggests that it should remain at the same level in 2010.

The postseason survey results indicate that adolescents of 78-95 mm were relatively abundant in 2008 and 2009.

The short historical series of the commercial fishery and postseason surveys do not provide much context for interpreting the catch rate declines observed in 2009. The quota can be

maintained, given 1) the stability in the four neighbouring areas, on which Area 16A is partially dependent and 2) the strong proportion of intermediate-shell crab in the Area 16A landings, which suggests a moderate exploitation rate.

Recommendation:

The status quo (2009) is recommended for 2010.

Fishing Period

A fishing period is determined for each area to reduce the handling of white crab (recently moulted), to avoid the selection of commercially valuable crabs and to limit the potential fishing effort.

The handling of white crab must be limited to reduce mortality of this portion of the population which is vulnerable and of low immediate value, both commercially and for reproduction. White crab will represent the prized resource harvested within a year or more. The abundance of white crab on the fishing grounds and in traps may increase from May to August according to when moulting has occurred and based on the abundance of hard crab (residual biomass) which could reduce its catchability.

A limited fishing period reduces the possibility of actively or passively selecting (Highgrading) crab of high commercial value and therefore reduces handling and accidental mortality of non-targeted categories of crab or of less commercial value.

A limited fishing period helps to protect the resource by preventing prolonged fishing effort or pressure when the resource is less abundant than expected.

Recommendation:

Overall, for the different areas, harvesting seasons and the length of the fishing period have contributed to protecting the resource.

It is recommended to begin the fishing season as early as possible in spring and to maintain the shortest possible fishing period.

Sources of Uncertainty

The quality of science advice depends mainly on the accuracy of the parameters obtained through sampling and the subsequent analyses. Information obtained from logbooks and purchase slips during the fishing season affects the accuracy of the parameters that are derived from these documents. For instance, abundance indices and fishing effort calculations obtained from logbooks may include errors that will affect the science advice provided. The selectivity and catchability of traps can vary depending on the type of trap used and trap volume and mesh size, the amount and quality of bait used and soak time, which can vary with the fishing strategies employed and the prevailing environmental conditions. The catchability of adolescent crabs and recruits could also be affected by the occurrence rate of intermediate-size crabs (condition 3) on the seafloor. The selective sorting of catches can also affect the quality of the data obtained.

The abundance and condition indices and the estimates of crab size that are obtained from the trawl and trap surveys depend on the type of gear used and are affected by uncertainties related to catchability variations in the different crab groups targeted. Some types of fishing gear are better suited to given seafloor areas than are other gear types and this factor influences the spatial coverage that is ultimately sampled. The biological characteristics of snow crab can in themselves create sources of uncertainty that impinge on the science advice. For instance, the terminal moulting phase, which occurs at various sizes, will affect crab condition and catchability. Natural mortality can also vary with the life stage and condition of the crabs.

SOURCES OF INFORMATION

Dufour, R. and J.-P. Dallaire 2003. Status of snow crab populations in the St. Lawrence Estuary and the Northern Gulf of St. Lawrence from 1999 to 2001. DFO Can. Sci. Advis. Sec., Res. Doc. 2003/048.

DFO, 2009. Assessment of the Estuary and Northern Gulf of St. Lawrence (Areas 13 to 17 and 12A, 12B, 12C and 16A) Snow Crab Stocks in 2008. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2009/027.

FOR MORE INFORMATION

Contact: Jean Lambert
Maurice Lamontagne Institute
850, route de la Mer
P.O. Box 1000
Mont-Joli (Quebec)
G5H 3Z4
Tel: (418) 775-0717
Fax: (418) 775-0740
E-Mail: Jean.Lambert@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Quebec Region
Fisheries and Oceans Canada
Maurice-Lamontagne Institute
P.O. Box 1000, Mont-Joli
Quebec Canada
G5H 3Z4

Telephone: (418) 775-0825
Fax: (418) 775-0679
E-Mail: Bras@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)
© Her Majesty the Queen in Right of Canada, 2010

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2010. Assessment of the Estuary and Northern Gulf of St. Lawrence (Areas 13 to 17, 12A, 12B, 12C and 16A) Snow Crab Stocks in 2009. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2010/029.